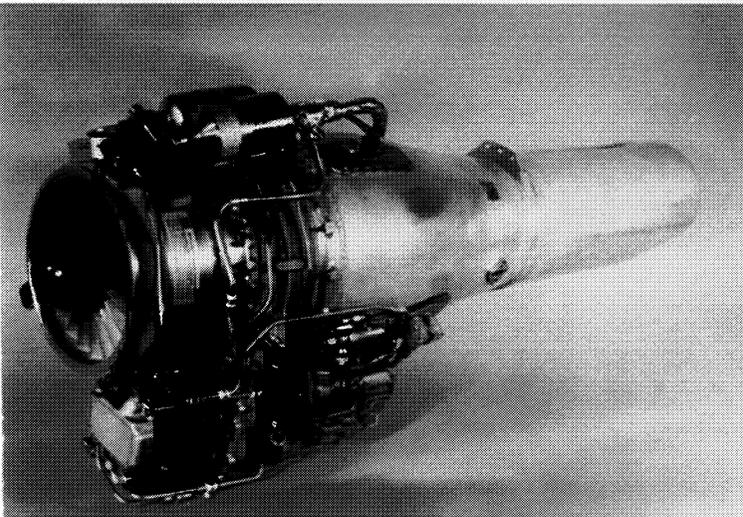


## Cruise Missile Engines

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Beginning this year, the Department of Defense plans to deploy two types of cruise missiles. One, shown above, is the Navy-sponsored Tomahawk, developed by General Dynamics Corporation; the Tomahawk can be launched from submarines and surface ships or from land bases. The other is the Air Force AGM-86B Air Launched Cruise Missile (ALCM), developed and manufactured by The Boeing Company. Cruise missiles are necessarily small, so they need a small but highly efficient engine to propel them over long distances at relatively high speeds. The Tomahawk and the ALCM are powered by the same type of engine, a Williams F107 fanjet (left) that produces about 600 pounds thrust, is one foot in diameter and weighs only 141 pounds. The engine is manufactured by Williams International, Walled Lake, Michigan, one of the world's largest producers of small gas turbines for aircraft, automotive, industrial and marine applications.

In developing the F107 engine, the Williams International design engineering staff used a computer program from the inventory of NASA's Computer Software Management and Information Center (COSMIC)<sup>®</sup>, which routinely supplies such programs as a service to industry (see page 66). The COSMIC program was used in calculating airflows in the engine's internal ducting; flow analysis is a design step toward assuring optimum flow rate, which results in a more efficient engine with increased thrust and reduced fuel consumption. The company also uses the COSMIC software on an ongoing basis as new projects are initiated.

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